HF Radar Real-Time Quality Assurance and Quality Control

Hugh Roarty, Laura Nazzaro, Josh Kohut
Rutgers University

Teresa Updyke
Old Dominion University

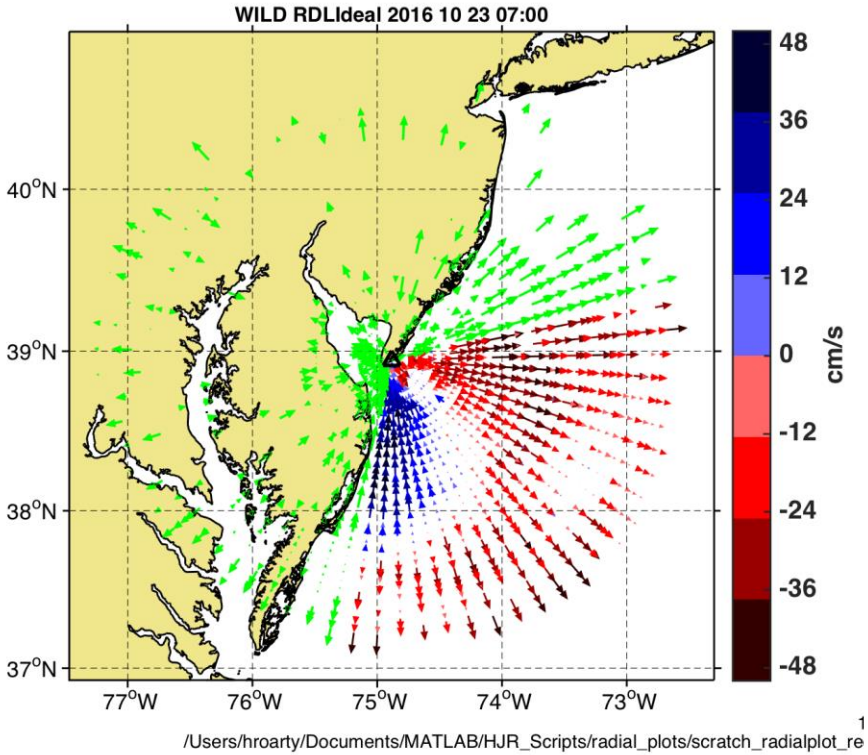
Outline

- Radial Quality Control
- QARTOD Flags

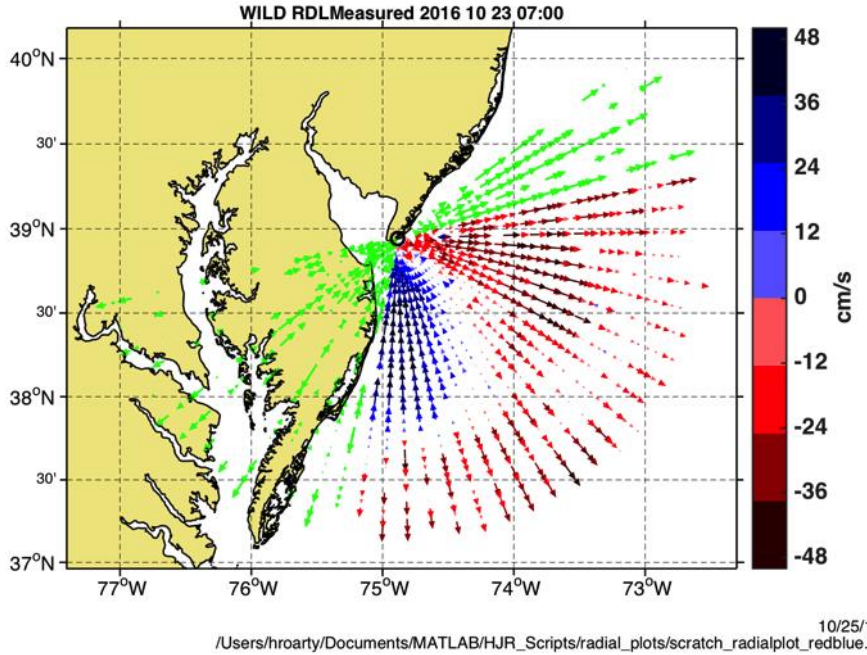
Radial Quality Control

Radial Evaluation

IDEAL



MEASURED



SeaSonde Uncertainties (Qualities)

```
%TableColumnTypes: LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV ERSC ERTC XDST YDST RNGE BEAR VELO HEAD SPRC
%TableRows: 952
%TableStart:
%%   Longitude   Latitude    U comp   V comp  VectorFlag  Spatial    Temporal    Velocity    Velocity  Spatial  Temporal  Distanc
%%     (deg)       (deg)     (cm/s)   (cm/s)  (GridCode)  Quality    Quality     Maximum     Minimum   Count    Count     (km)
   -74.1970712  39.6427222  -0.779  -22.286          0      3.702      6.296      27.383      18.670       3        5    0.1055
   -74.1940089  39.6425358  -2.234  -18.183          0      3.844      4.798      23.961      16.336       2        4    0.3683
   -74.1909793  39.6421437  -4.870  -22.904          0      7.607     11.527      31.429      14.313       3        3    0.6284
   -74.1880055  39.6415488  -6.098  -19.936          0      6.535      3.371      24.116      17.580       2        6    0.8837
```

The spatial and temporal qualities are based on standard deviations of velocities.

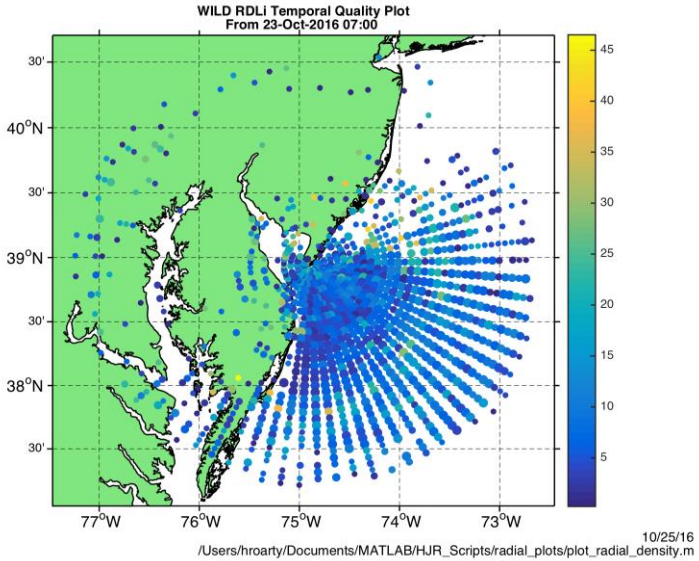
The counts indicate the number of velocities that were used for the computation of those standard deviations.

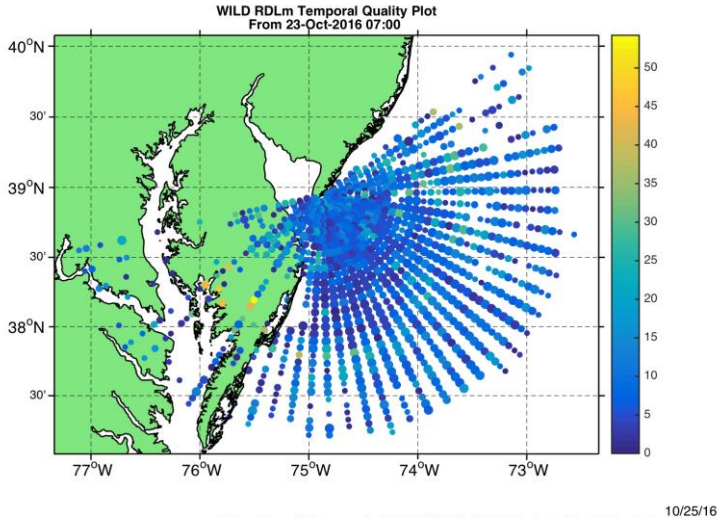
SeaSonde Uncertainties

IDEAL

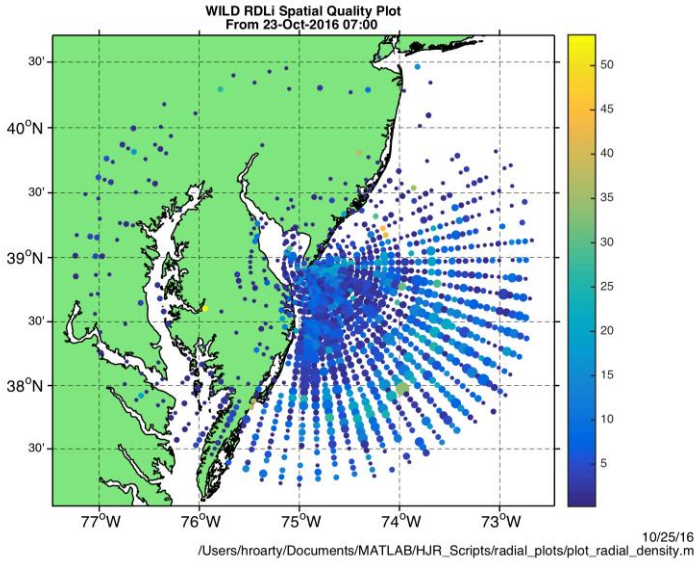
MEASURED

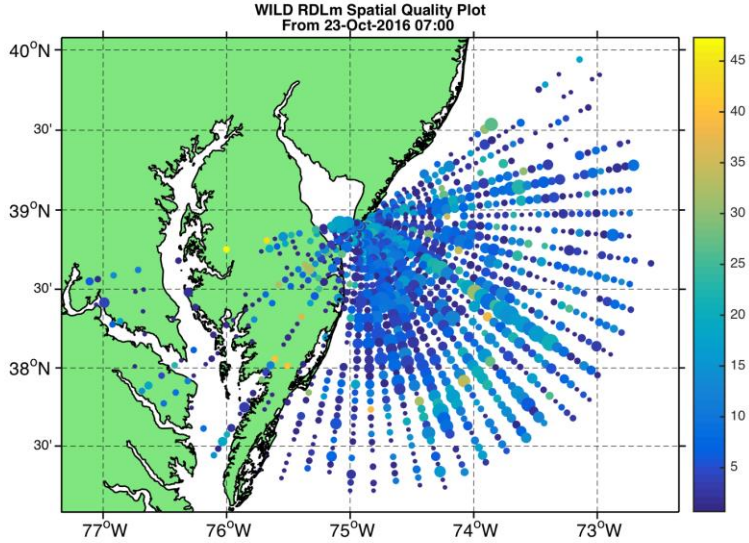
TEMPORAL





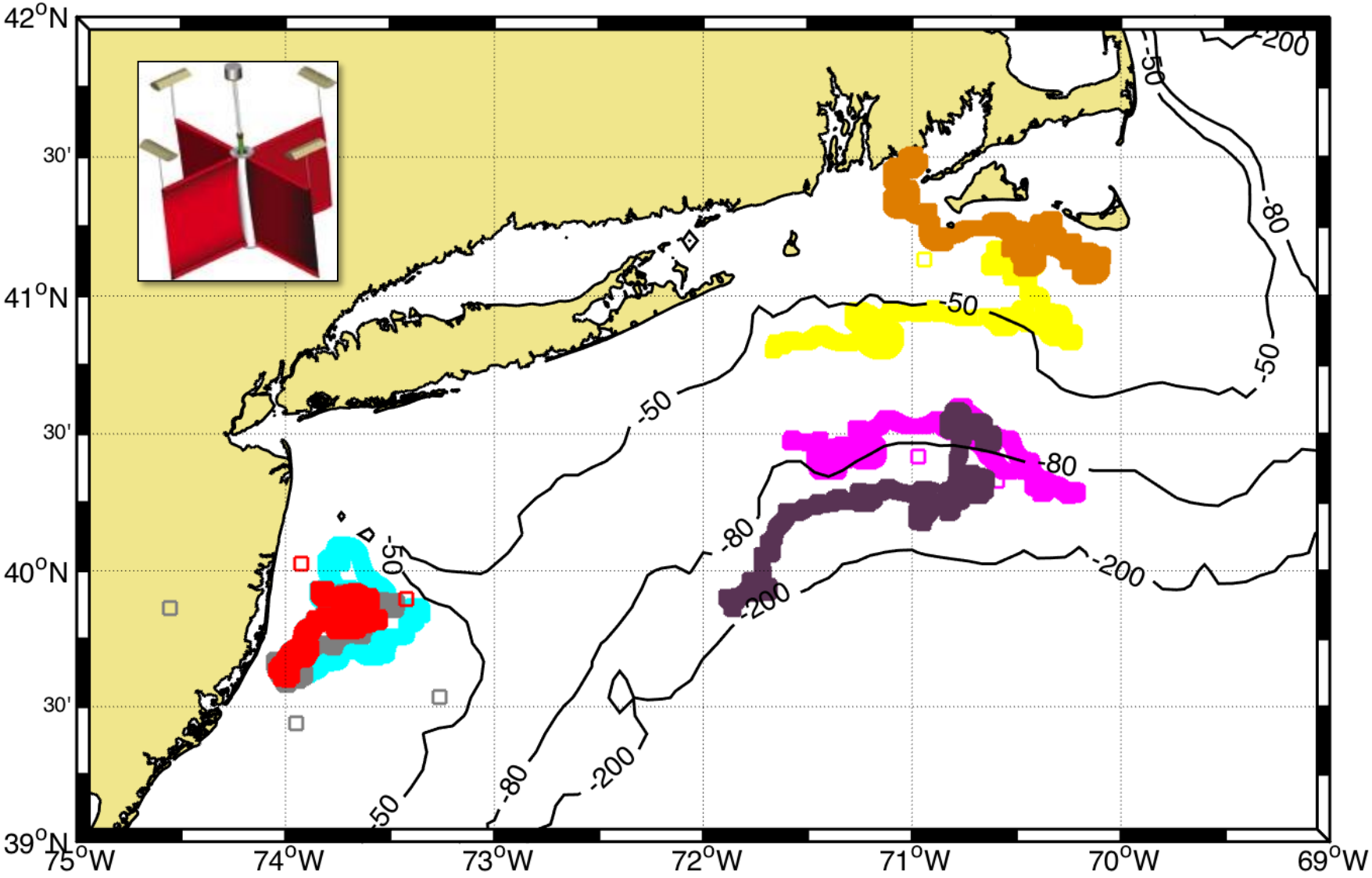
SPATIAL



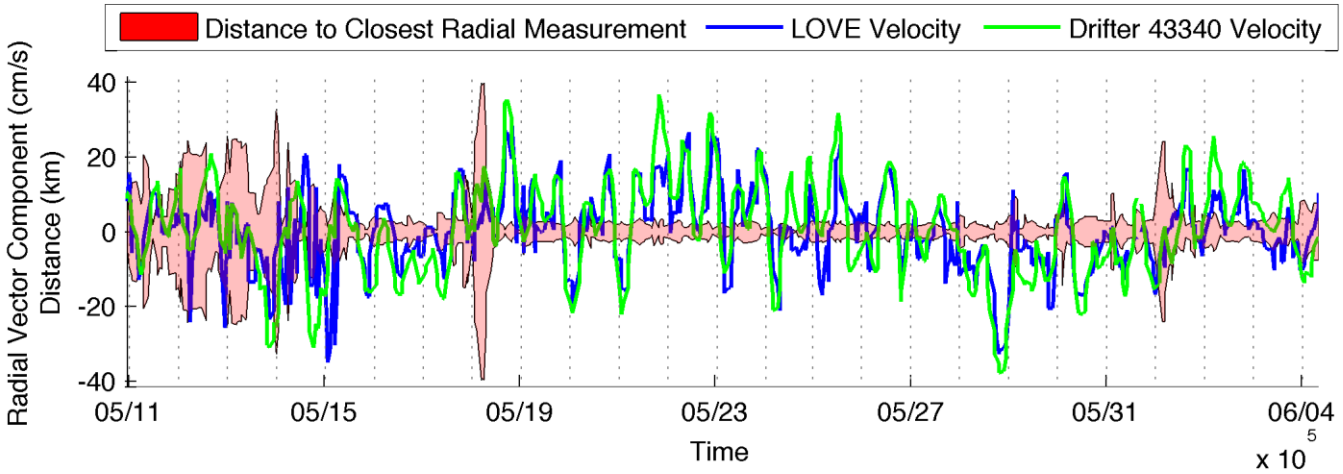


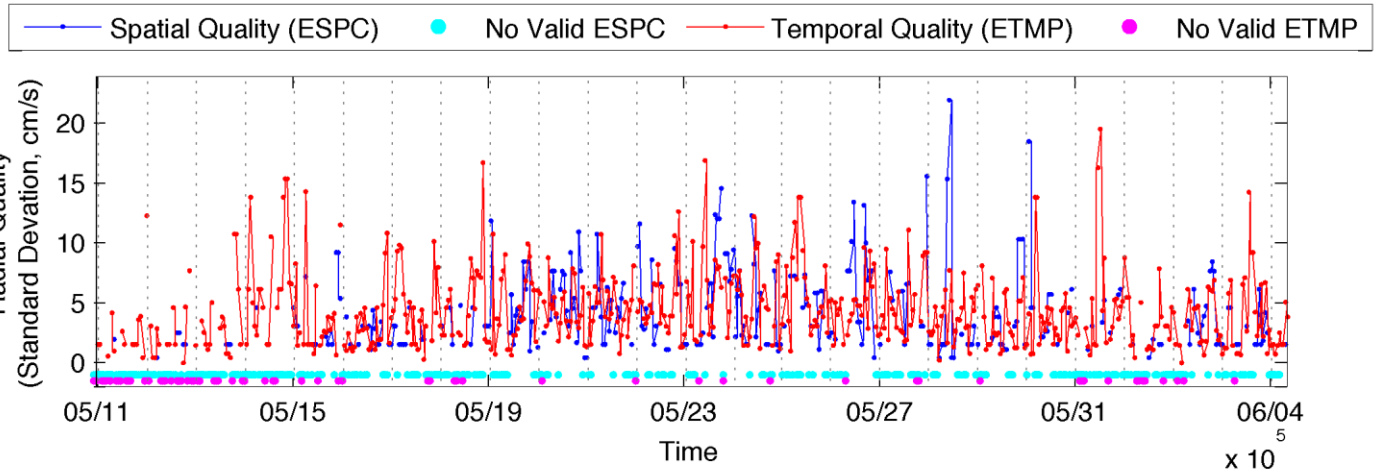
MARA
Ocean Information for a Changing World

Normalized Cumulative Lagrangian Separation
Liu and Weisberg (2011)



Radial Drifter Comparison

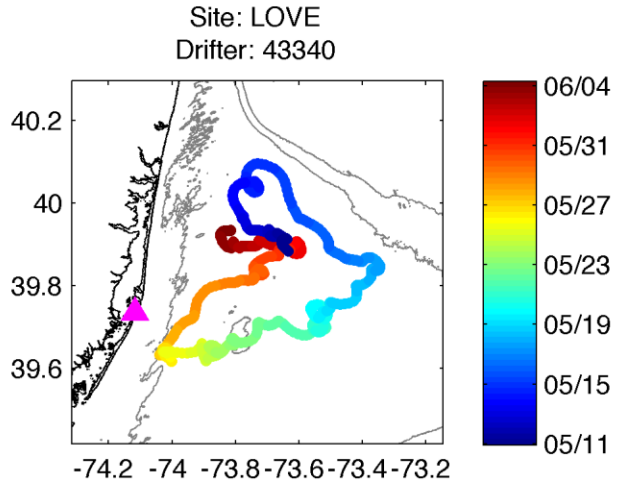


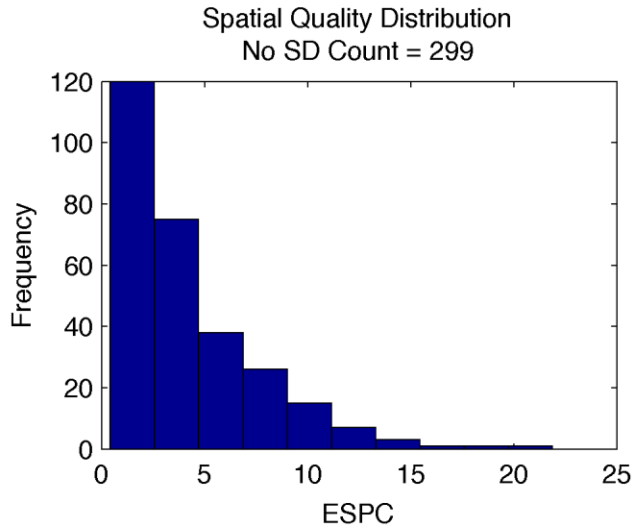


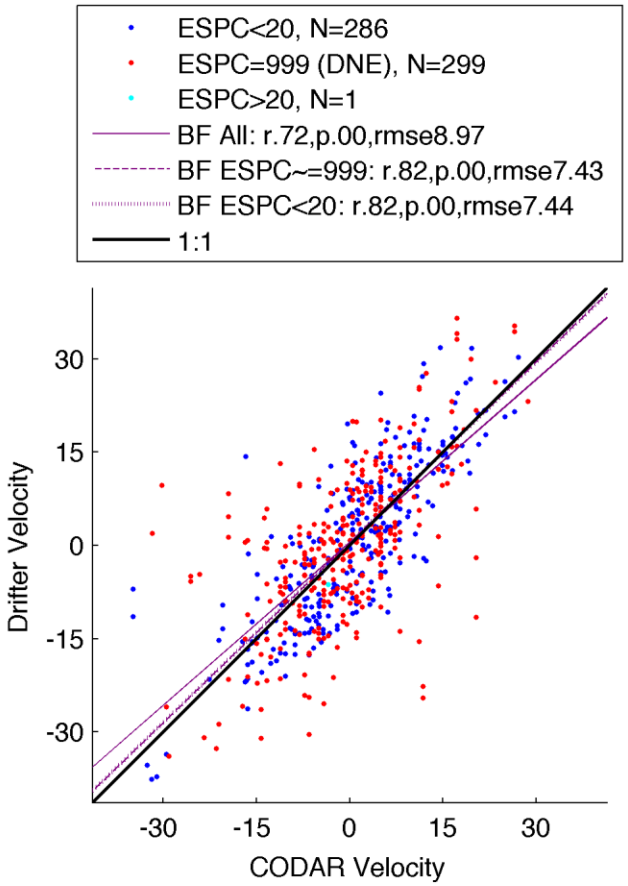
MARACOOS
Ocean Information for a Changing World

IOOS | EYES ON THE OCEAN

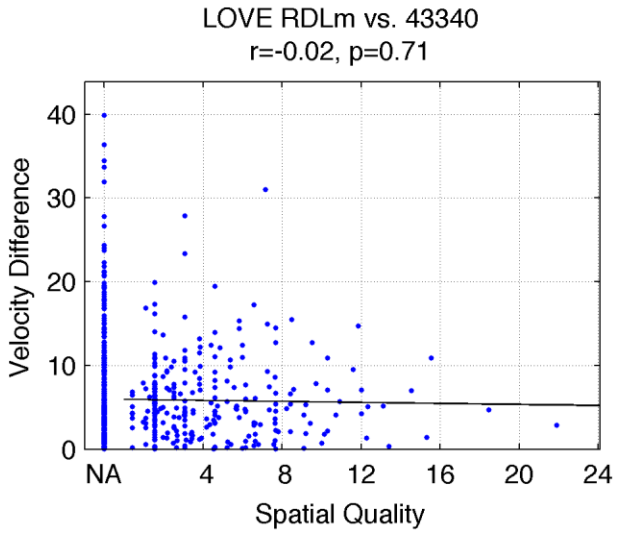
Radial Drifter Comparison

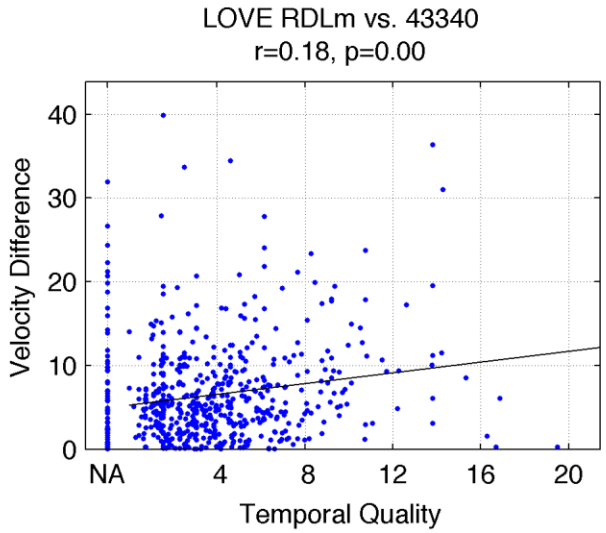


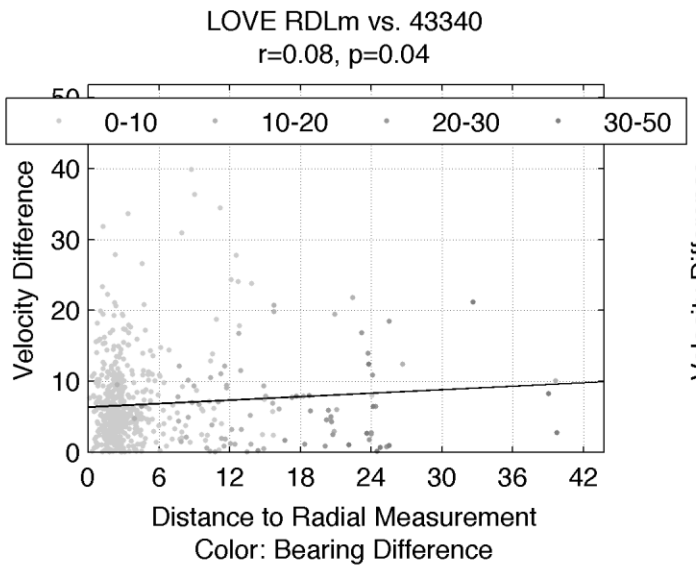


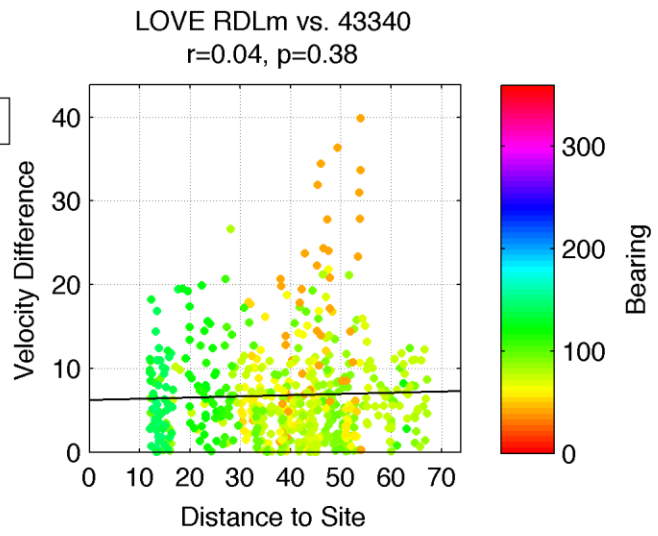


Radial Drifter Comparison









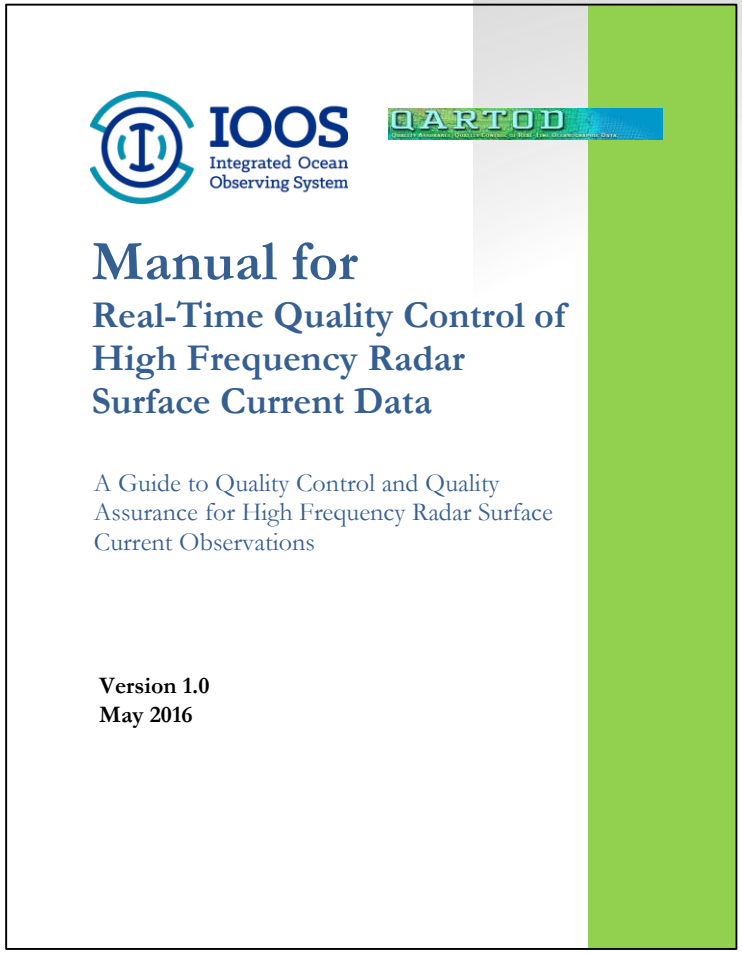
Application of QARTOD

QARTOD -Seven Laws of Data Management

1. Every real-time observation distributed to the ocean community must be accompanied by a quality descriptor.
2. All observations should be subject to some level of automated real-time quality test.
3. Quality flags and quality test descriptions must be sufficiently described in the accompanying metadata.
4. Observers should independently verify or calibrate a sensor before deployment.
5. Observers should describe their method / calibration in the real-time metadata.
6. Observers should quantify the level of calibration accuracy and the associated expected error bounds.
7. Manual checks on the automated procedures, the real-time data collected and the status of the observing system must be provided by the observer on a time-scale appropriate to ensure the integrity of the observing system.

QARTOD HFR -2016

	Test		Required
Spectra	1	SNR	X
	2	Eigenvalues	
	3	Single DOA	
	4	DOA Width	
	5	Pos. Definiteness	X
Radials	6	Syntax	X
	7	Max Threshold	X
	8	Valid Location	X
	9	Radial Count	
	10	Spatial Median Filter	
	11	Temporal Gradient	
	12	Average Radial Bearing	
	13	Synthetic Radial	
Totals	14	Number Vectors	X
	15	GDOP	X
	16	Max Threshold	X
	17	Spatial Median	



QARTOD Flags

The IOC 54:V3 Primary Level flagging standard (UNESCO 2013) is shown in table 1.

Table 1. Primary Level Flagging Standard

Value	Primary-Level Flag Short Name	Definition
1	Good	Passed documented required QC tests
2	Not evaluated, not available or unknown	Used for data when no QC test performed or the information on quality is not available
3	Questionable/suspect	Failed non-critical documented metric or subjective test(s)
4	Bad	Failed critical documented QC test(s) or as assigned by the data provider
9	Missing data	Used as place holder when data are missing

A summary flag is set to the highest level flag found in the detailed tests outlined in U.S. IOOS data quality manuals.

Flags – Radial Data

Velocity (cm/s)	Direction (True)	Spectra RngCell	Global Rng Flag	Trend Flag	StuckSnsr Flag	Gradient Flag	Summary Flag
10.549	190.0	1	1	1	1	1	1
7.709	215.0	1	1	1	1	1	1
9.533	220.0	1	1	1	1	1	1
9.939	230.0	1	1	1	1	1	1
7.913	235.0	1	1	1	1	1	1
10.549	240.0	1	1	1	1	1	1
4.057	255.0	1	1	1	1	1	1
2.334	260.0	1	1	1	1	1	1
6.291	265.0	1	1	1	1	1	1
1.623	275.0	1	1	1	1	1	1
-25.157	290.0	1	4	1	1	1	4
-21.708	295.0	1	4	1	1	1	4
-17.651	300.0	1	1	4	1	1	4

Metadata

%RadialBraggPeakDropOff: 100.000

%RadialBraggPeakNull: 10.000

%RadialBraggNoiseThreshold: 4.000

%PatternAmplitudeCorrections: 1.0000 1.0000

%PatternPhaseCorrections: -150.00 -135.00

%PatternAmplitudeCalculations: 0.1591 0.2268

%PatternPhaseCalculations: 175.80 -133.60

%RadialMusicParameters: 40.000 20.000 2.000

%QCFlagReference: Quality control reference:IOOS QARTOD HF Radar ver 1.0 2016

%QCFlagDefinitions: 1=Pass 2=Not Evaluated 3=Suspect 4=Fail 9=Missing Data

%QCTimespan: current file + 2 before and after

%GRNGFlagThresholds: GlobalRange=200

%TRNDFlagThresholds:

%STCKFlagThresholds: stuck_resolution=0.01 stuck_num=3

%GRADFlagThresholds: gradient_threshold=0.005

%STCKFlagThresholds: stuck_resolution=0.01 stuck_num=3

%GRADFlagThresholds: gradient_threshold=0.005

%TableColumns: 23

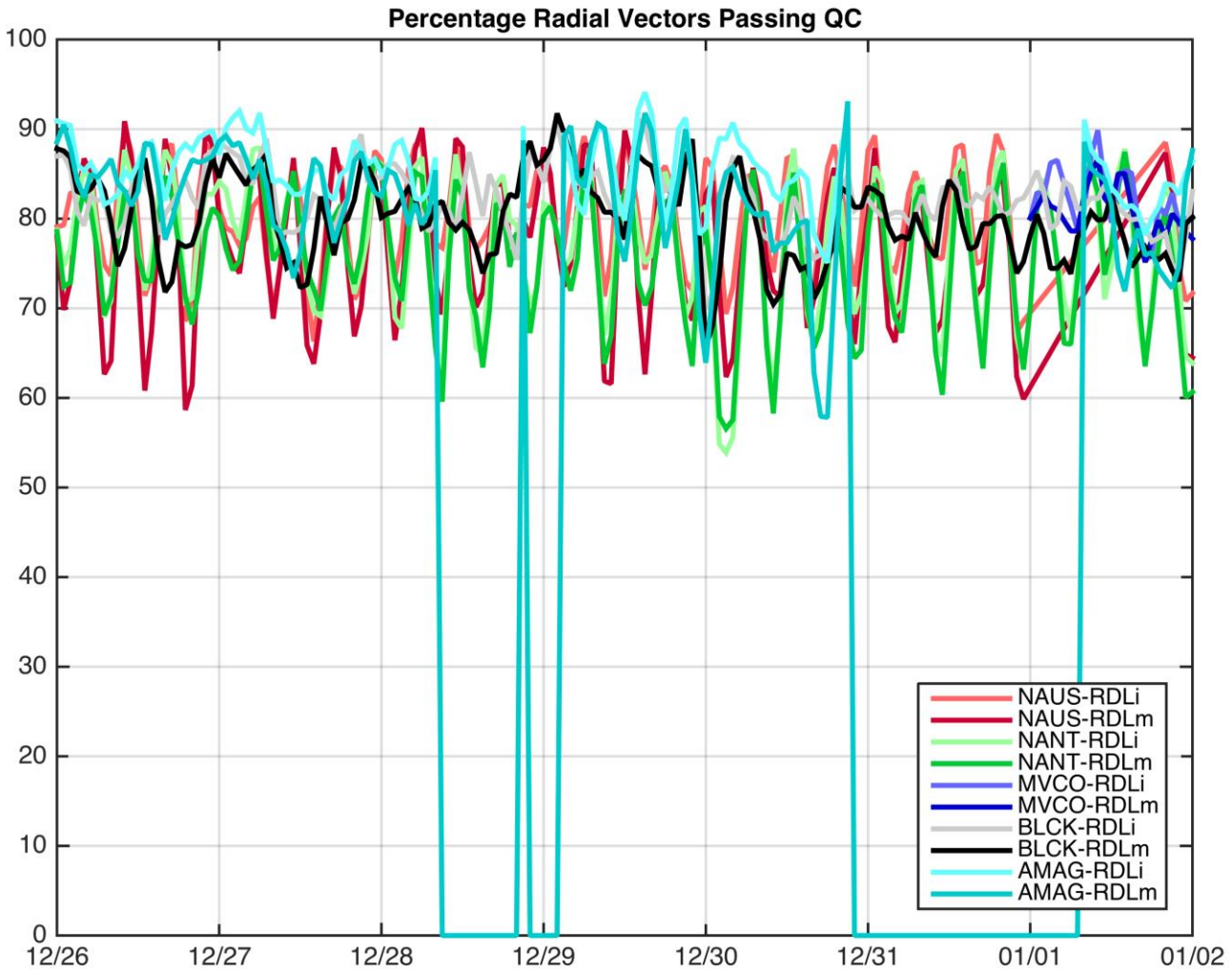
%TableColumnTypes: LOND LATD VELU VELV VFLG ESPC ETMP MAXV MINV ERSC ERTC XDST YDST RNGE BEAR VELO HEAD SPRC GRNG TRND STCK GRAD SFLG

File Naming

RDLm_AMAG_2016_06_05_0000.ruv

RDLm_AMAG_2016_06_05_0000.qcv

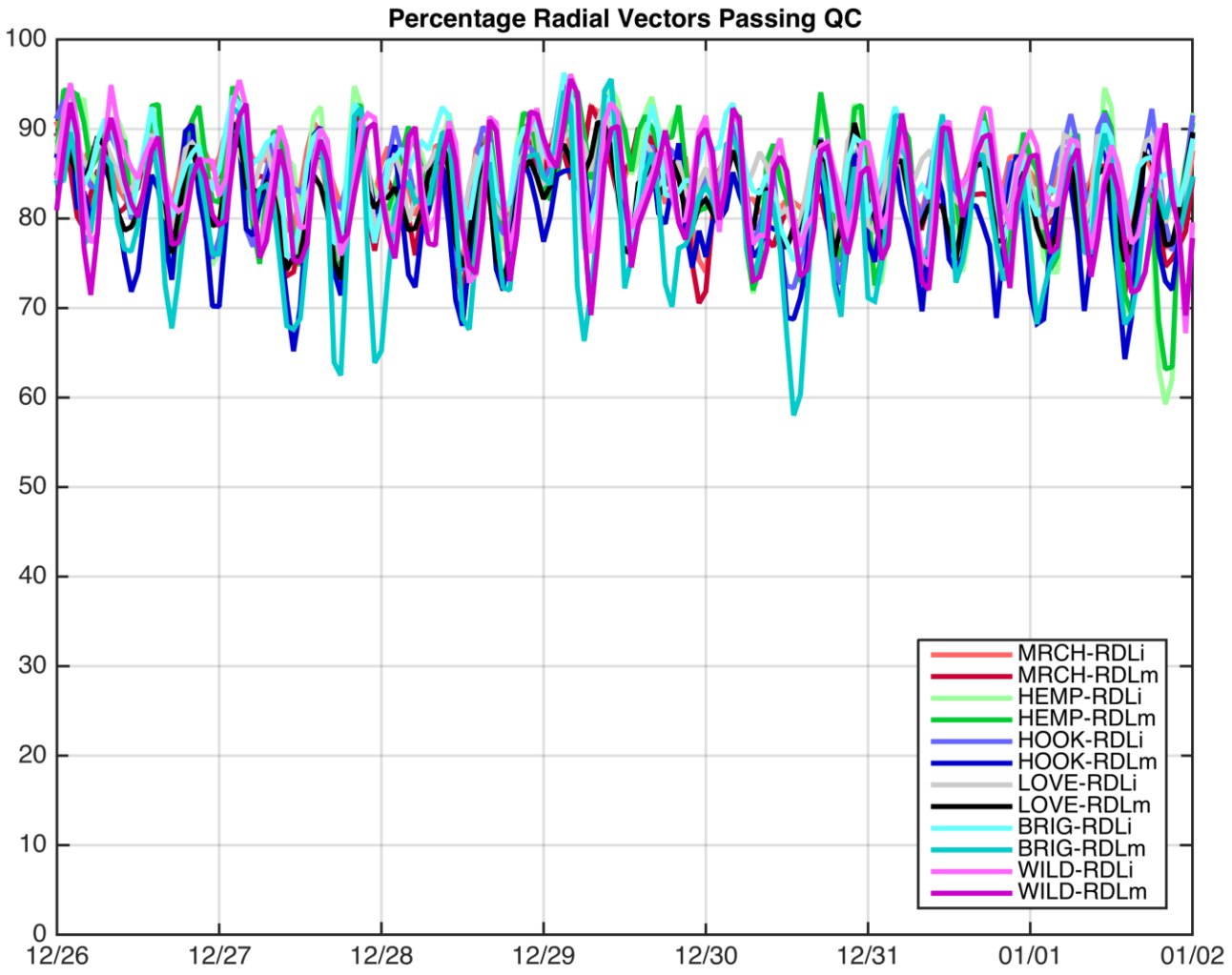
Percent Passing



02/02/17

/home/hroarty/codar/MARACOOS/Time_Series_Radial/MARCdriver_plot_radial_qc_flag_ts.m

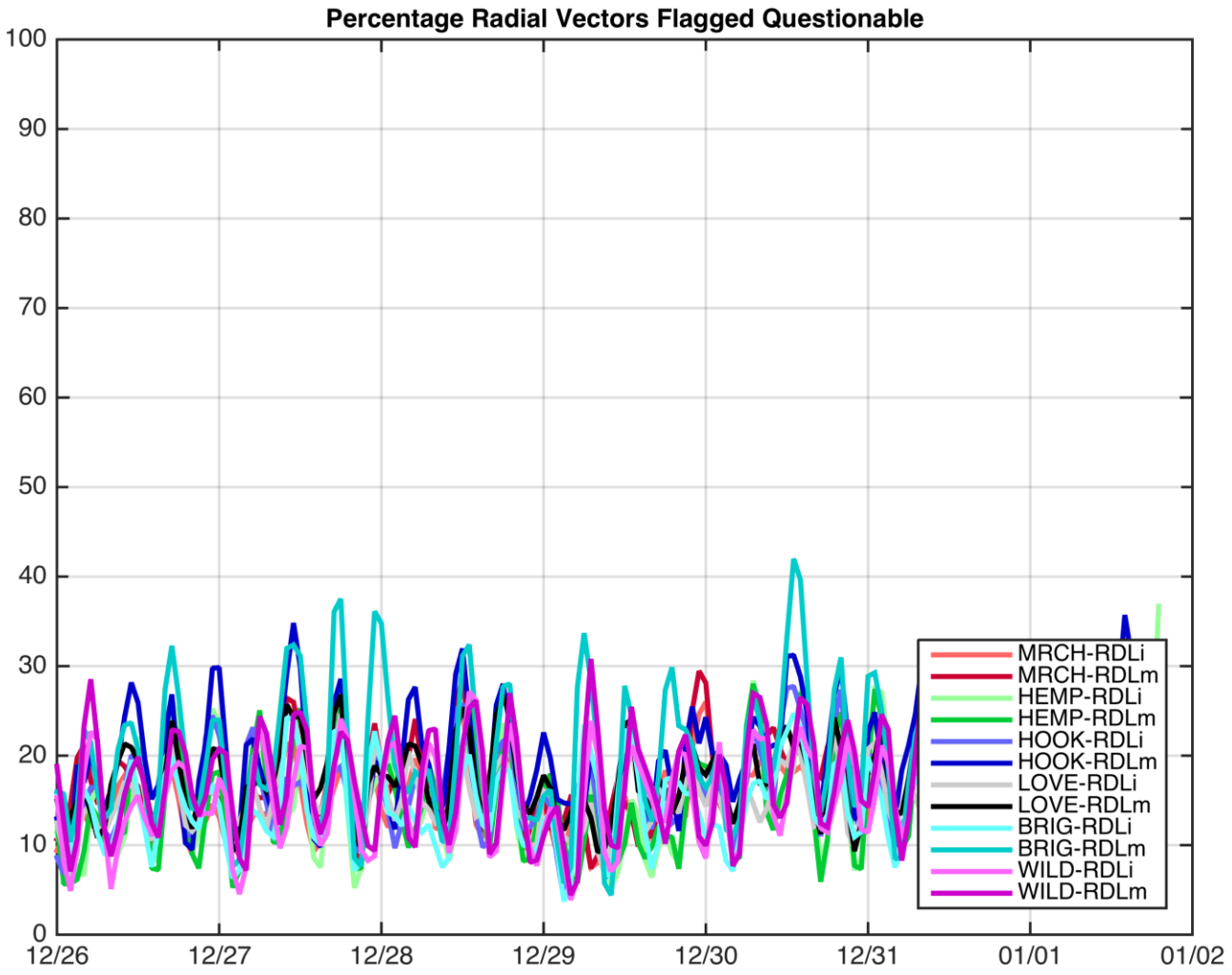
Percent Passing



02/02/17

/home/hroarty/codar/MARACOOS/Time_Series_Radial/MARCdriver_plot_radial_qc_flag_ts.m

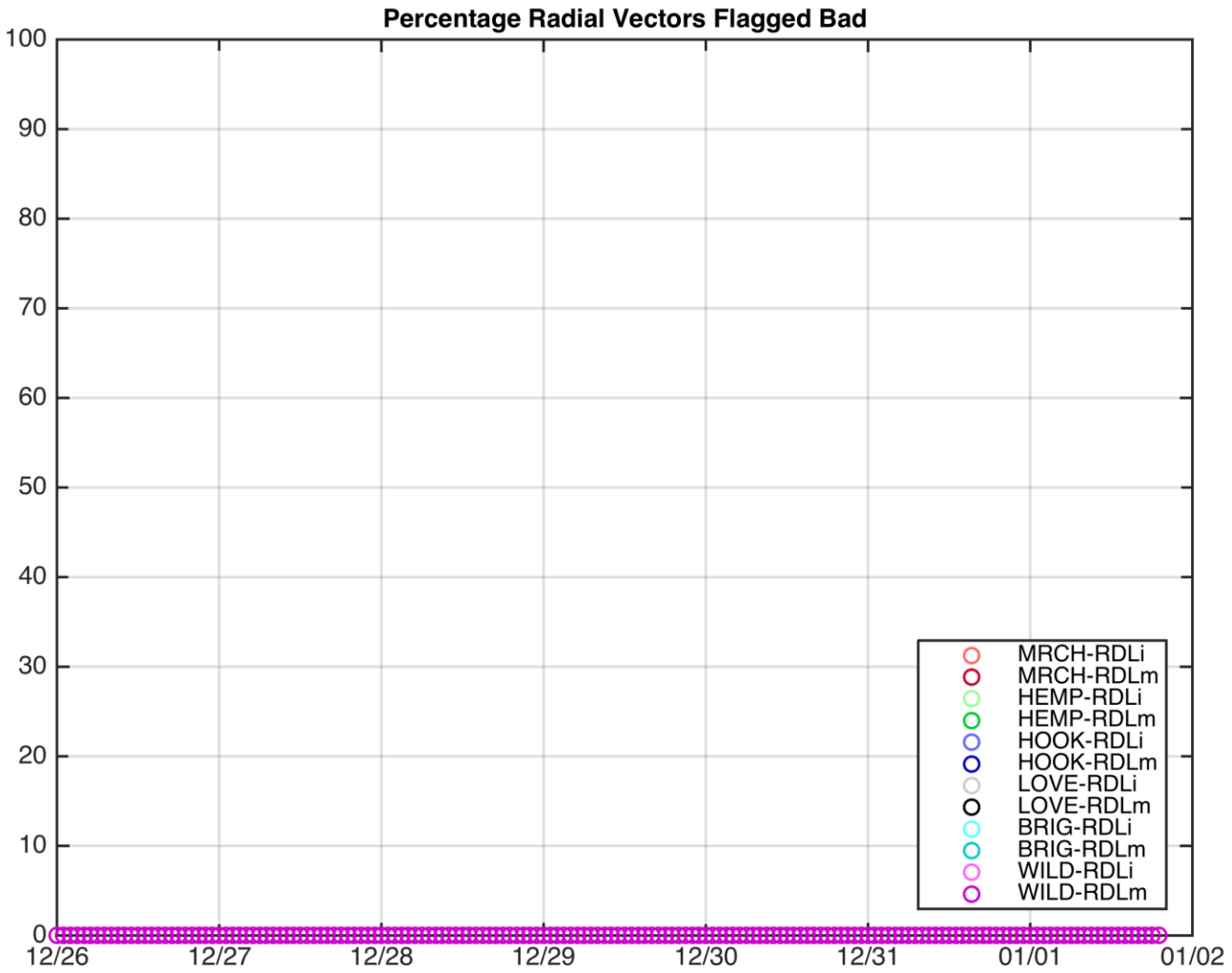
Questionable Flags



02/02/17

/home/hroarty/codar/MARACOOS/Time_Series_Radial/MARCdriver_plot_radial_qc_flag_ts.m

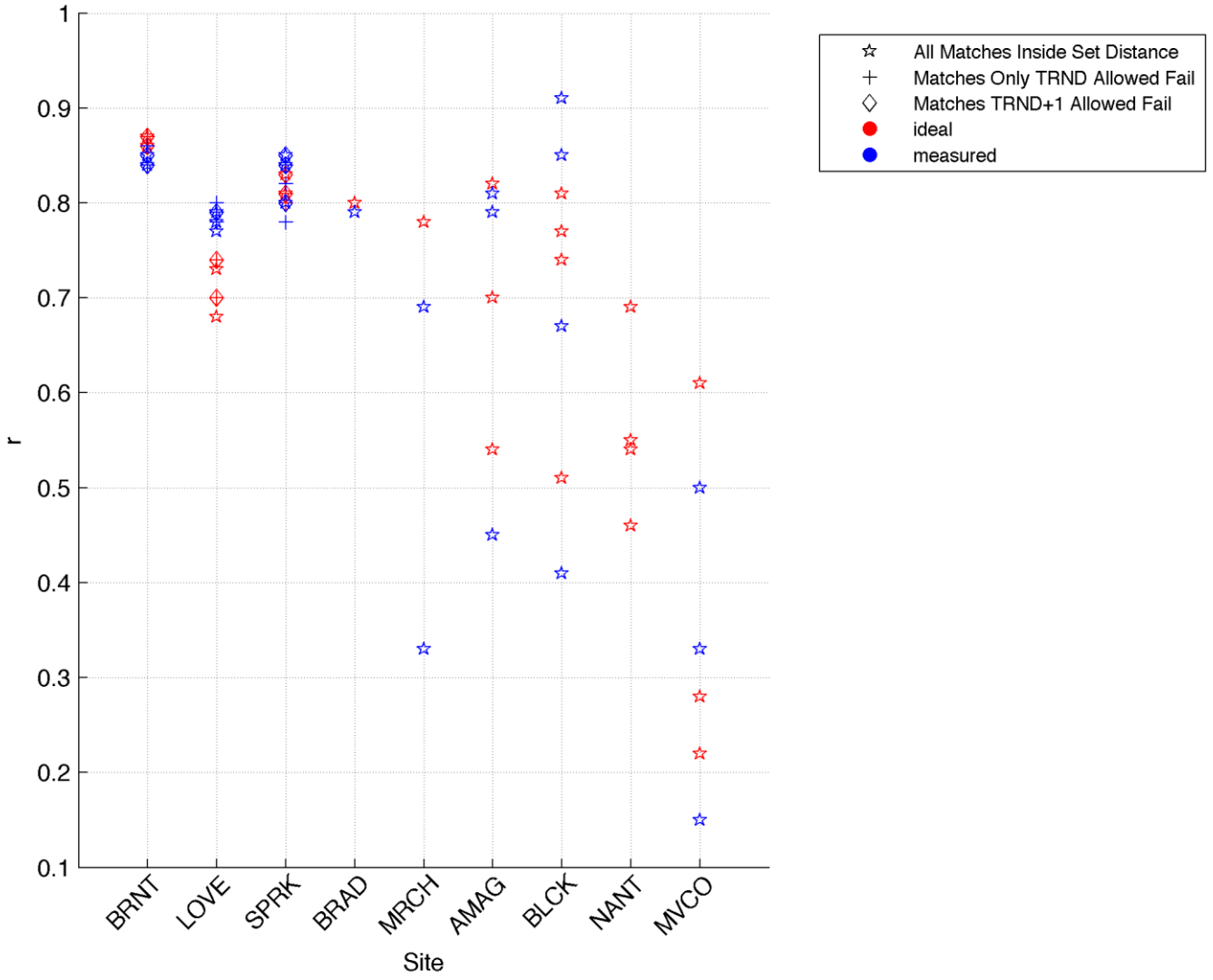
Percent Failing



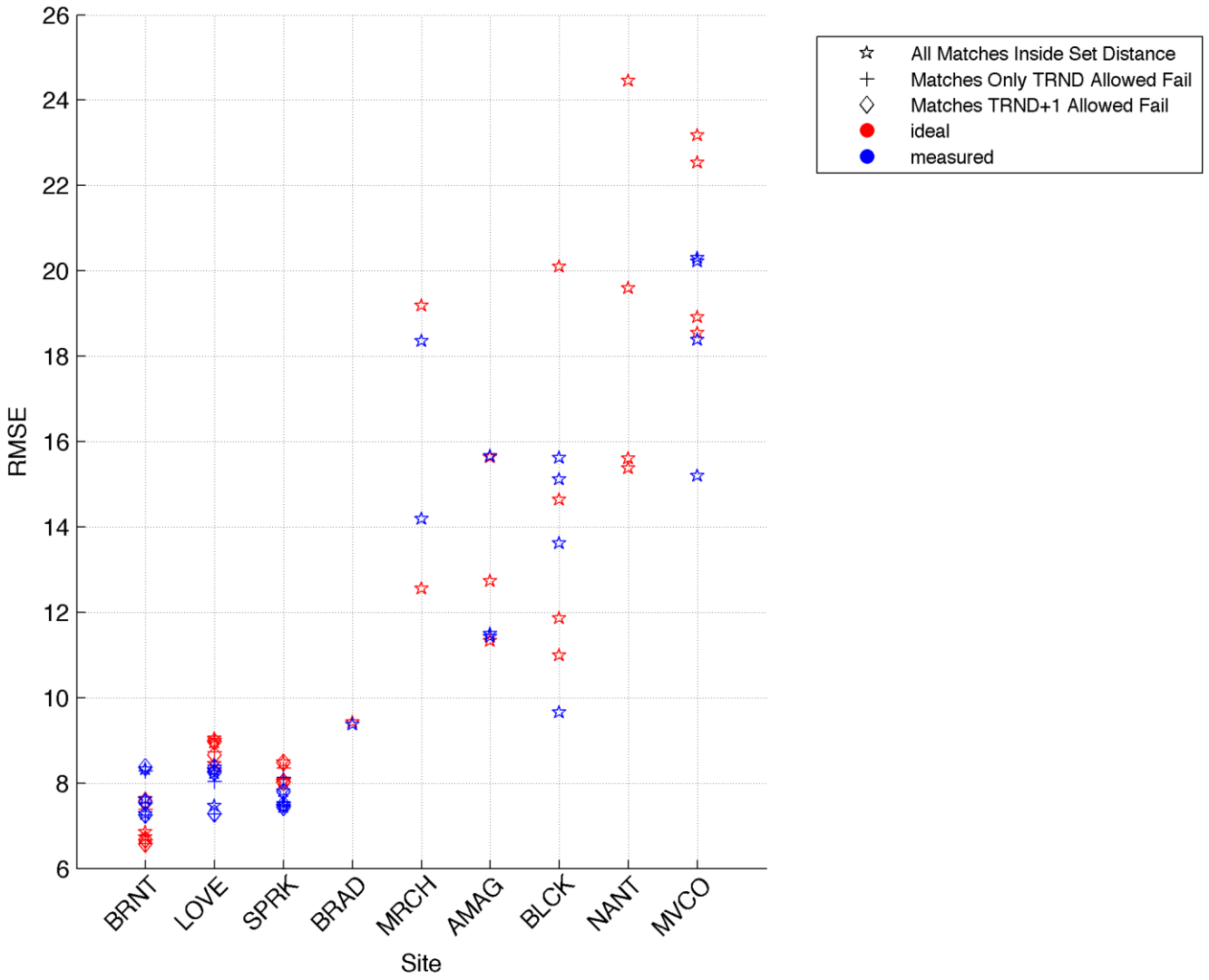
02/02/17

/home/hroarty/codar/MARACOOS/Time_Series_Radial/MARCdriver_plot_radial_qc_flag_ts.m

Correlation with Drifter Radial Velocity



RMSE with Drifter Radial Velocity



Next Steps

- Evaluate additional QC tests including spatial tests
- Present results at HF radar operator meeting in March
- Implement required QARTOD tests in the real-time processing by April 1

HF Radar Real Time Quality Assurance and Quality Control

THANK YOU